THE DIET OF NESTLING STRAW-NECKED IBIS, *THRESKIORNIS SPINICOLLIS*, AT CAPEL, WESTERN AUSTRALIA

By R.K. HART
School of Biological Sciences and Biotechnology, Murdoch University, Murdoch, Western Australia 6150, Australia

K.M. MCROBERTS
School of Veterinary Studies, Murdoch University, Murdoch, Western Australia 6150, Australia

and M.C. CALVER
School of Biological Sciences and Biotechnology, Murdoch University, Murdoch, Western Australia 6150, Australia

ABSTRACT

The diet of nestling Straw-necked Ibis near Capel, Western Australia was determined by examining the gizzard contents of 18 moribund birds aged approximately four to seven weeks old which were collected at the nest. We identified a total of 1240 invertebrate prey recovered from 19 prey taxa. The number of prey in each taxon, the volume of stomach contents they represented and the proportion of birds feeding on each taxon were recorded and used to calculate an Index of Relative Importance for each prey taxon. The top five ranking prey for nestlings 4–5 weeks old were lepidopteran larvae, two species of scarab beetles, a carabid beetle and an unknown terrestrial crustacean. Nestlings 5–6 weeks old ranked a scarab beetle highest, followed by a carabid beetle, unidentified pupae, another scarab beetle and an unidentified beetle. Nestlings 6–7 weeks old ranked lepidopteran larvae highest, followed by snails, two species of scarab beetle and a carabid beetle. Overall, the nestling diet was similar to that reported for adult Straw-necked Ibis in other studies. There was no evidence that the nestlings had died because of poor nutrition.

INTRODUCTION

The Straw-necked Ibis (*Threskiornis spinicollis*) inhabits marshlands and drier land where arthropods are abundant (Blakers *et al* 1984). Barker and Vestjens (1989) summarised the diet of adult birds on the basis of studies across Australia. They found that a range of aquatic and terrestrial arthropods predominated, although molluscs, earthworms, plant seeds and vertebrates including fish, frogs, lizards, snakes and rodents were also taken. Several authors reported that Straw-necked Ibis ate large numbers of swarming locusts, grasshoppers or crickets (e.g., Crossman 1909, Gubanyi 1910, McKeown 1934, Ellis 1958, Serventy and Whittell 1976), although Carrick (1959) doubted that this had a significant impact on grasshopper populations. However, the food of adult birds need not reflect the prey they select for their nestlings (e.g., Royama 1970), and we were unable to locate any published descriptions of the diets of nestling Straw-necked Ibis. In this paper we describe the diet of nestling Straw-necked Ibis, based on examination of 1240 invertebrate prey from the gizzards of 18 moribund nestlings collected at the nest.

METHODS

The nestlings came from a breeding colony estimated at *c.* 2000 birds located near the town of Capel, south-west Western Australia in 1993 (33°38'S, 115°33'E). The colony was being monitored as part of a study of high nestling mortality (McRoberts, unpublished). To minimise disturbance generally, nests near the edge of the colony were visited weekly to monitor laying, hatching and survival of the nestlings to fledging. Eighteen moribund nestlings ranging in age from four to seven weeks were collected during these observations and grouped into birds aged 4–5 weeks old (seven birds), 5–6 weeks old (six birds) and 6–7 weeks old (five birds). Ages were calculated based on the date that hatchlings were first observed in a nest. The nestlings were euthanased for pathology studies and the stomach contents were retrieved immediately after death and preserved in 70% ethanol. They were subsequently sorted using a dissecting microscope and 19 different prey taxa identified.

We recorded the number of birds in each age class which had fed on each prey taxon as well as the volume and number of each type of prey and expressed these values as percentages. Used alone, each of these measures may be biased. For example, a prey taxon may be present in small numbers or amounts in almost all birds and so will have a very high frequency of occurrence, although it is not very important in the diet by bulk. Small foods such as seeds or ants may be present in very large numbers but not contribute greatly by bulk, while a small number of large prey may contribute substantially to volumetric estimates, but only be present in a small group of predators. Therefore we calculated an Index of Relative Importance (IRI) (Pinkas 1971) for each age class of bird using the formula: $IRI = (N + V)F$, where N = numerical %, V = volumetric %, and F = frequency of occurrence % (Pinkas 1971). The main advantage of the composite index is that it incorporates data from all three components and

Table 1. Foods of nestling Straw-necked Ibis. See text for details of different measures.

Prey	Age of nestlings (weeks) 4-5 % vol.	% no.	% freq.	IRI	5-6 % vol.	% no.	% freq.	IRI	6-7 % vol.	% no.	% freq.	IRI
Lepidoptera larvae	16.0	27.5	57.1	2483.8	6.3	8.8	33.0	498.3	84.8	69.9	100.0	15470.0
Scarab beetle 1	0.9	1.7	42.9	111.5	3.2	3.2	50.0	320.0	0.6	0.7	60.0	78.0
Scarab beetle 2	9.6	14.6	85.7	2073.9	48.4	6.4	100	5480.0	1.5	3.2	100.0	470.0
Scarab beetle 3	6.9	18.5	42.9	1089.7	5.3	16	50.0	1065.0	1.5	4.8	60.0	378.0
Carabidae	4.0	12.1	57.1	919.3	9.5	33.6	50.0	2155.0	0.9	2.3	40.0	128.0
Beetle larvae	0.5	0.7	28.6	34.3	0.0	0.0	0.0	0.0	0.6	0.7	40.0	52.0
Unknown beetle	0.9	1.5	28.6	68.6	3.2	8.0	50	560.0	0.6	2.1	40.0	108.0
Ephemeroptera larva	0.9	1.7	28.6	74.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leech	1.2	4.5	28.6	163.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Centipede	0.8	0.4	14.3	17.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown fly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	20.0	18.0
Unknown fly larva	0.2	0.4	14.3	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Earwig	0.9	4.1	28.6	143.0	0.0	0.0	0.0	0.0	0.9	1.2	60.0	126.0
Cricket	0.2	0.2	14.3	5.7	0.0	0.0	0.0	0.0	0.4	0.4	20.0	16.0
Cockroach	0.3	0.2	14.3	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wolf spider	1.4	2.8	42.9	180.2	0.0	0.0	0.0	0.0	0.4	0.4	40.0	32.0
Gastropod	5.2	6.2	42.9	489.1	0.0	0.0	0.0	0.0	5.2	10.8	40.0	640.0
Unknown crustacean	50.3	3.0	14.3	762.2	6.3	1.6	16.7	131.9	0.0	0.0	0.0	0.0
Unknown pupae	0.0	0.0	0.0	0.0	17.9	22.4	33.0	1330.0	2.6	2.8	20.0	108.0
Total number of prey	535				125				565			
Total number of birds	7				6				5			

reduces the risk of bias associated with using one of the components alone. The relative IRI rankings for prey categories taken by the three age classes were compared using Spearman's rank correlation coefficient, using the Bonferroni correction of $\alpha = 0.017$ for each test to reduce the possibility of Type 1 error because of the multiple hypotheses.

RESULTS

A total of 1240 invertebrate prey recovered from 19 prey taxa were identified, with 535 coming from seven birds 4–5 weeks old, 125 from six birds 5–6 weeks old and 565 from five birds 6–7 weeks old (Table 1). The average number of prey/bird was 68 (range 1 – 413), and the median was 23. The top five ranking prey for nestlings 4–5 weeks old were lepidopteran larvae, two species of scarab beetles, a carabid beetle and an unknown terrestrial crustacean. Nestlings 5–6 weeks old ranked a scarab beetle highest, followed by a carabid beetle, unidentified pupae, another scarab beetle and an unidentified beetle. Nestlings 6–7 weeks old ranked lepidopteran larvae highest, followed by snails, two species of scarab beetle and a carabid beetle. The orders of prey rankings for 4–5 week old vs 5–6 week old nestlings were not significantly correlated, after using the Bonferroni correction of $\alpha = 0.017$ ($r_s = 0.462$, $p = 0.046$). Significant correlations of prey rankings occurred between prey rankings of 4–5 week old nestlings and 6–7 week old nestlings ($r_s = 0.557$, $p = 0.013$) and between prey rankings of 5–6 week old nestlings and 6–7 week old nestlings ($r_s = 0.597$, $p = 0.007$).

DISCUSSION

The Straw-necked Ibis was rare in the south-west of Western Australia until the 1890s and breeding was not reported until the 1950s (Serventy and Whittell 1976, Blakers *et al.* 1984). They also observed that the species benefits from the irrigation of agricultural lands, so the transformation of large areas of the south-west by agriculture during the late nineteenth and early twentieth centuries (see maps in Jarvis 1986) probably contributed to its establishment. Large flocks of *c.* 300 birds were first reported near Capel in the early 1980s (WA Bird Report 1982).

The most highly ranked foods of the nestlings at Capel were lepidopteran larvae and a range of beetles. Although nestlings 5–6 weeks old had significantly different prey rankings to nestlings 4–5 weeks old, they did not differ in prey rankings to nestlings 6–7 weeks old. This suggests that the changes were probably a consequence of changes in prey availability rather than deliberate selection of particular prey for nestlings of certain ages. A similar situation has been reported for nestling Rainbow Bee-eaters (Calver *et al.* 1987).

Overall, the nestling diet was broadly similar to that of adults from across Australia reported by Barker and Vestjens (1989). The major difference was the absence of vertebrate prey and aquatic invertebrates such as water beetles and freshwater crayfish in the nestling diets, whereas Barker and Vestjens (1989) show that both occur with moderate frequency in the diet of adults. This was probably a function of sample size, given that only 18 nestlings were examined. Carrick (1959) noted that adult Straw-necked Ibis could vary markedly in the prey types in their stomachs, even though they foraged together. He attributed this to different prey choices or skills at prey capture by individual birds. Therefore the stomach contents of the nestlings would reflect the preferences and feeding skills of their parents. However, Barker and Vestjens (1989) did not note pupae as a food of Straw-necked Ibis, so the record from Capel may be the first of Straw-necked Ibis eating pupae.

ACKNOWLEDGEMENTS

We thank Dr Stuart Halse, Department of Conservation and Land Management, for financial support in initiating the study at Capel and the many volunteers who assisted with work in the field. Mr Ron Johnstone, Western Australian Museum, suggested useful references and Mr Michael Brooker, CSIRO Division of Wildlife and Ecology, made constructive comments on an early version of the manuscript.

REFERENCES

BARKER, R.D. and VESTJENS, W.J.M., 1989. The food of Australian birds. Vol I Non-passerines. CSIRO Division of Wildlife and Ecology: Lyneham, ACT

BLAKERS, M., DAVIES, S. J. J. F. and REILLY, P. N., ed, 1984. *The Atlas of Australian birds.* Melbourne University Press: Melbourne.

CALVER, M.C., SAUNDERS, D.A. and PORTER, B.D. 1987. The diet of the nestling Rainbow Bee-eater, *Merops ornatus*, on Rottnest Island Western Australia, and observations on a non-destructive method of diet analysis. *Australian Wildlife Research* 14: 541–550.

CARRICK, R. 1959. The food and feeding habits of the Straw-necked Ibis, *Threskiornis spinicollis* (Jameson), and the White Ibis, *T. molucca* (Cuvier), in Australia. *CSIRO Wildlife Research* 4: 69–92.

CROSSMAN, R.F. 1909. Birds seen at Cumminin Station, Western Australia. *Emu* 9: 84–90.

ELLIS, R. 1958. Observations on the Straw-necked Ibis. *Emu* 58: 312.

GUBANYI, C. 1910. Bird-Life on Sandy Creek, Riverina, New South Wales. *Emu* 10: 118–121.

JARVIS, N. (Ed) 1986. *Western Australia: An Atlas of Human Endeavour.* Department of Lands and Surveys Western Australia and Education Department of Western Australia: Perth, Western Australia.

MCKEOWN, K.C. 1934. The food of birds from south-western New South Wales. *Records of the Australian Museum* 19: 113–135.

PINKAS, L. 1971. Food habits study. *Fish Bulletin* 152: 5–10.

ROYAMA, T., 1970. Factors

governing the hunting behaviour and selection of food by the Great Tit (*Parus major* L.). *Journal of Animal Ecology* 39: 589–668.

SERVENTY, D.L. and WHITTELL, H.M. 1976. *Birds of Western Australia*. University of Western Australia Press: Perth, Western Australia.

WA BIRD REPORT 1982. *1984 RAOU Report No. 6.* Birds Australia: Melbourne.